

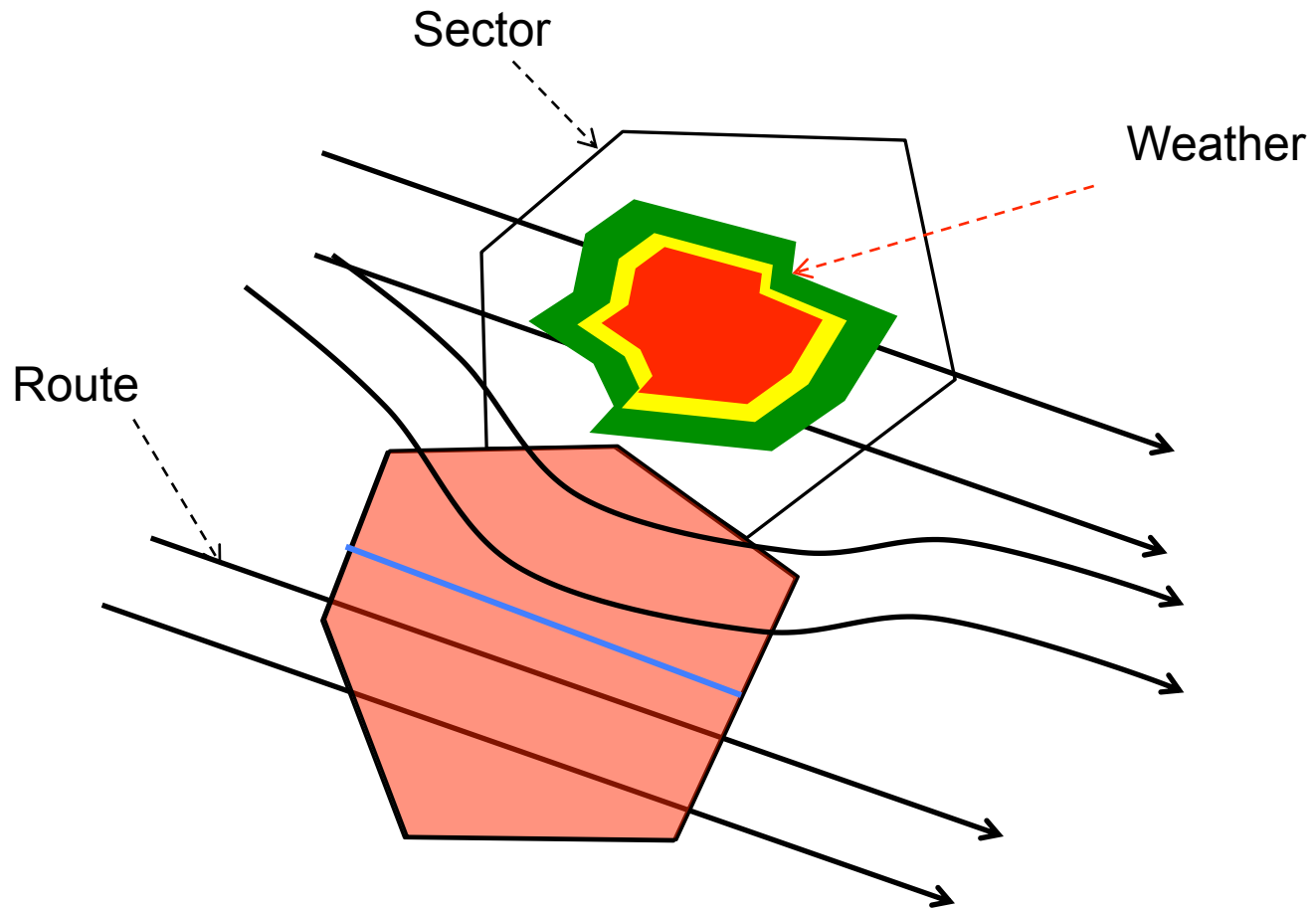
Benefits Assessment of the Interaction Between Traffic Flow Management Delay and Airspace Partitions in the Presence of Weather

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Main Message

- Weather diverts traffic flows to adjacent sectors causing departure and airborne delays
- In our study, departure delaying combined with airspace partitioning, as opposed to departure delaying only can have
 - a significant impact on reducing delay
 - at a cost of significant increase in the number of sectors

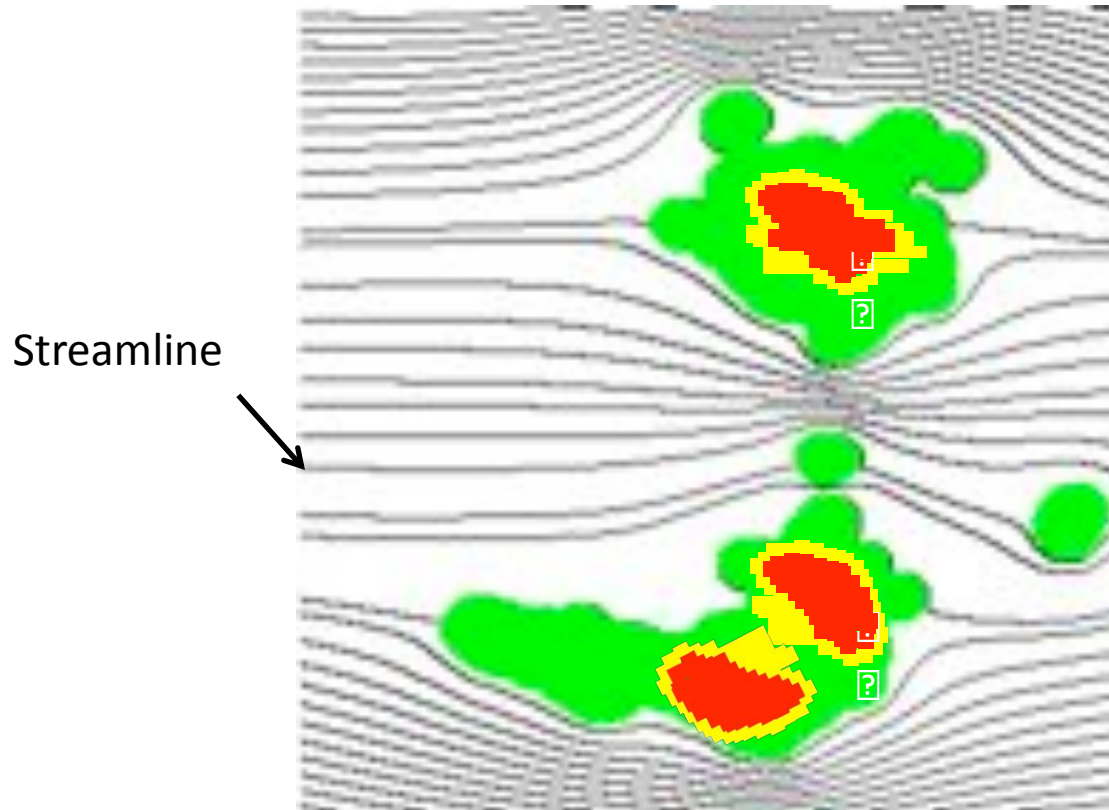
Outline

- Find Reroutes Around Weather
- Schedule Departure Delays and Select Routes
- Partition Airspace
- System Diagram
- Results
- Summary
- Conclusion and Recommendation

Find Reroutes Around Weather

- Given:
 - Weather that changes with time
 - Clear-weather route
- Objective: compute new routes that avoid weather

Streamline Method

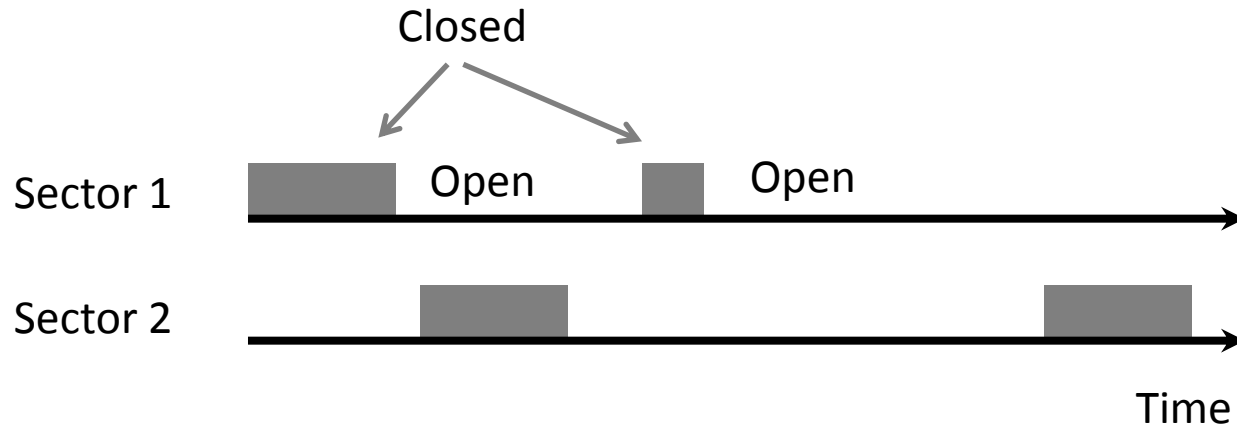


Create 4 possible routes around weather, each with an additional hour of departure delay

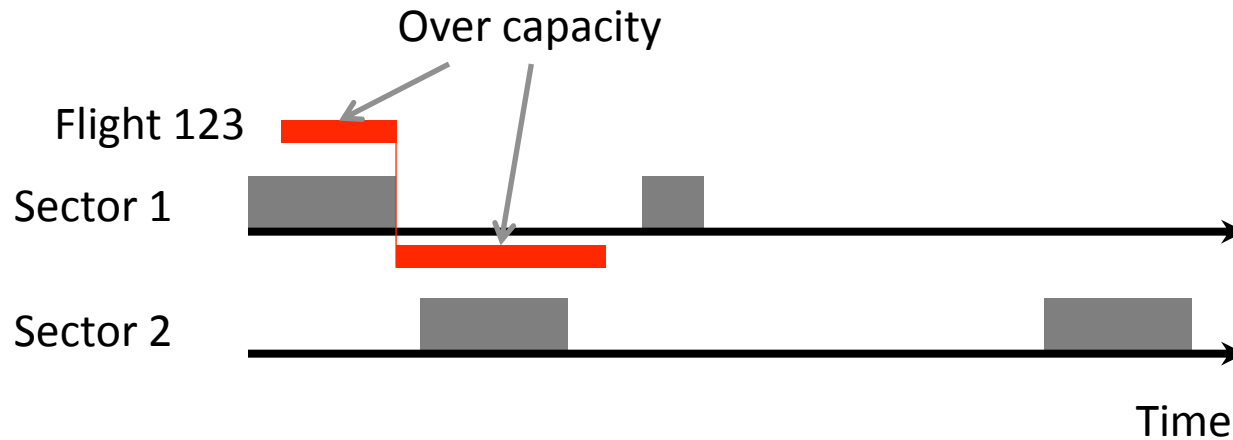
Schedule Departure Delays and Select Routes

- Given:
 - Departure-times and multiple routes
 - Airport arrival and departure rate constraints
- Objective: compute departure delays and select final routes such that delays are minimized
- Limitation: Sector capacity constraints are ignored

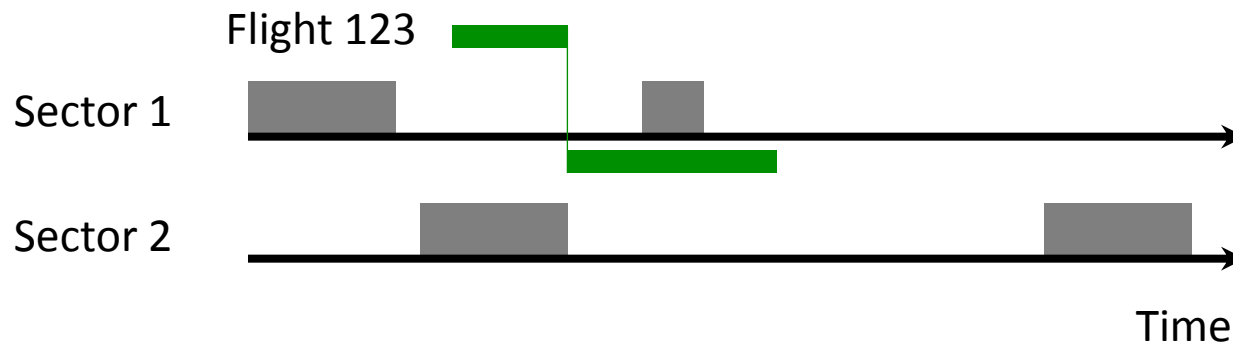
First-Come, First-Served Scheduler



First-Come, First-Served Scheduler



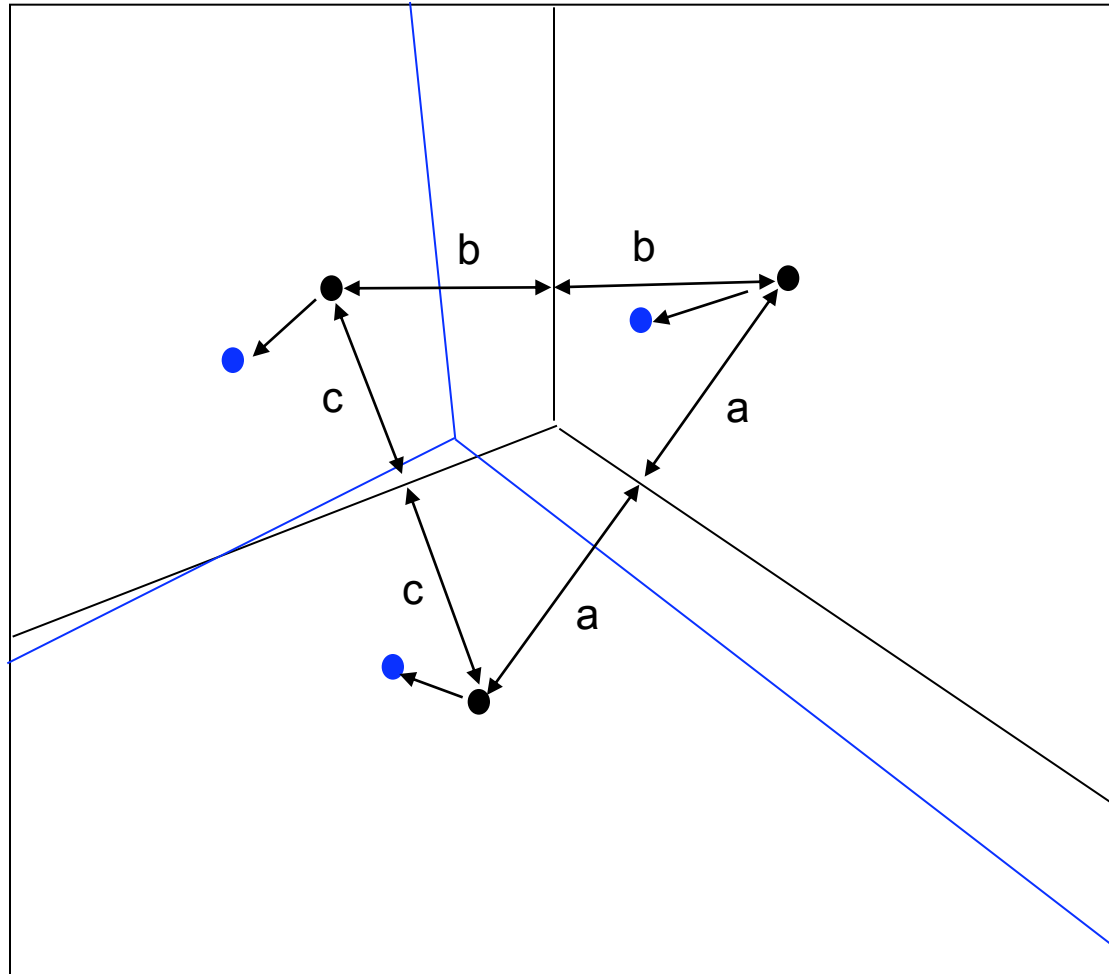
First-Come, First-Served Scheduler



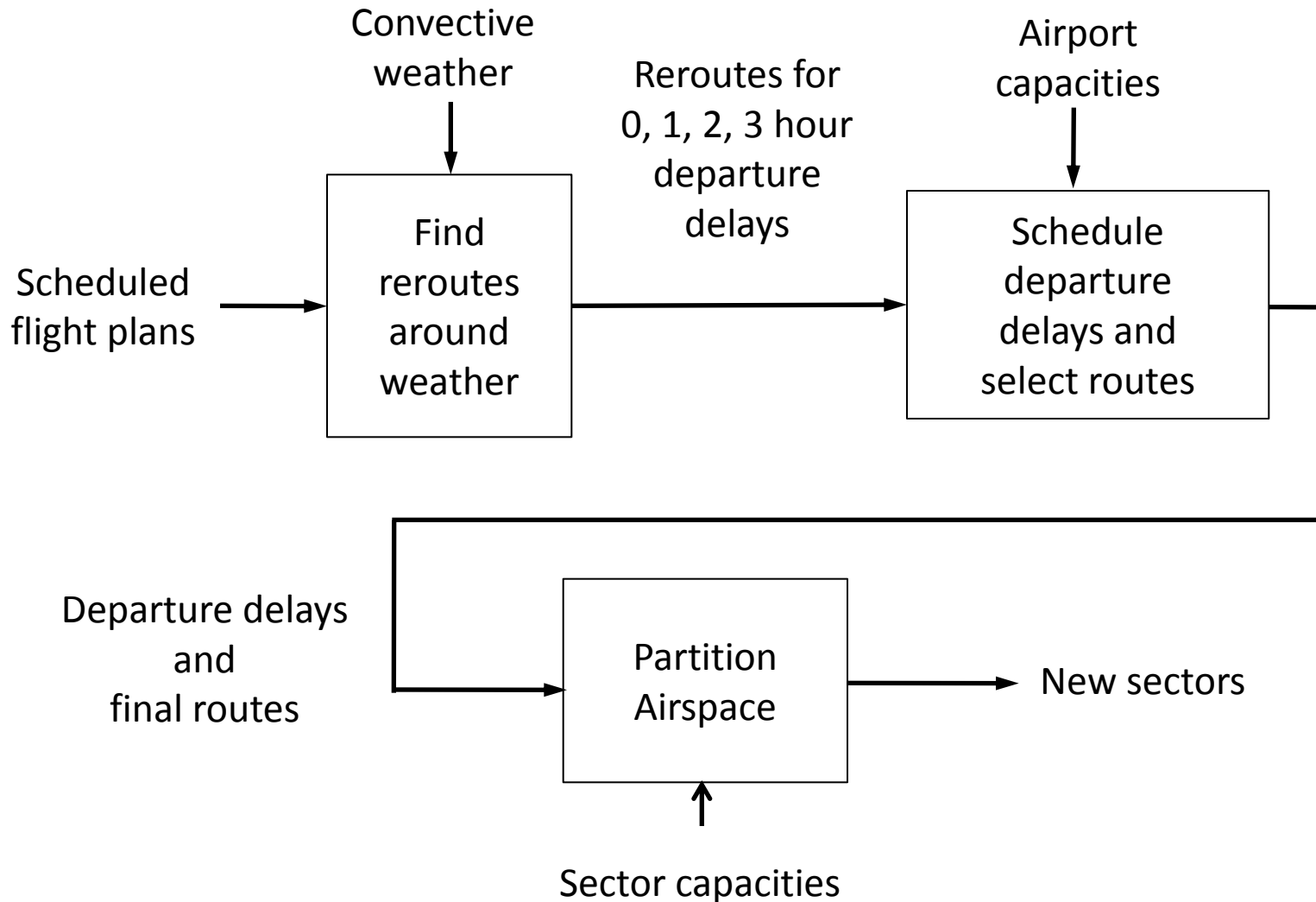
Partition Airspace

- Given:
 - Flight trajectories
 - Sector capacity constraints
- Objective: compute sector boundaries such that
 - Sector flight counts are balanced
 - Delays are reduced
- Limitation: Airport capacity constraints are ignored

Airspace Partitioning Process



System Diagram



Results

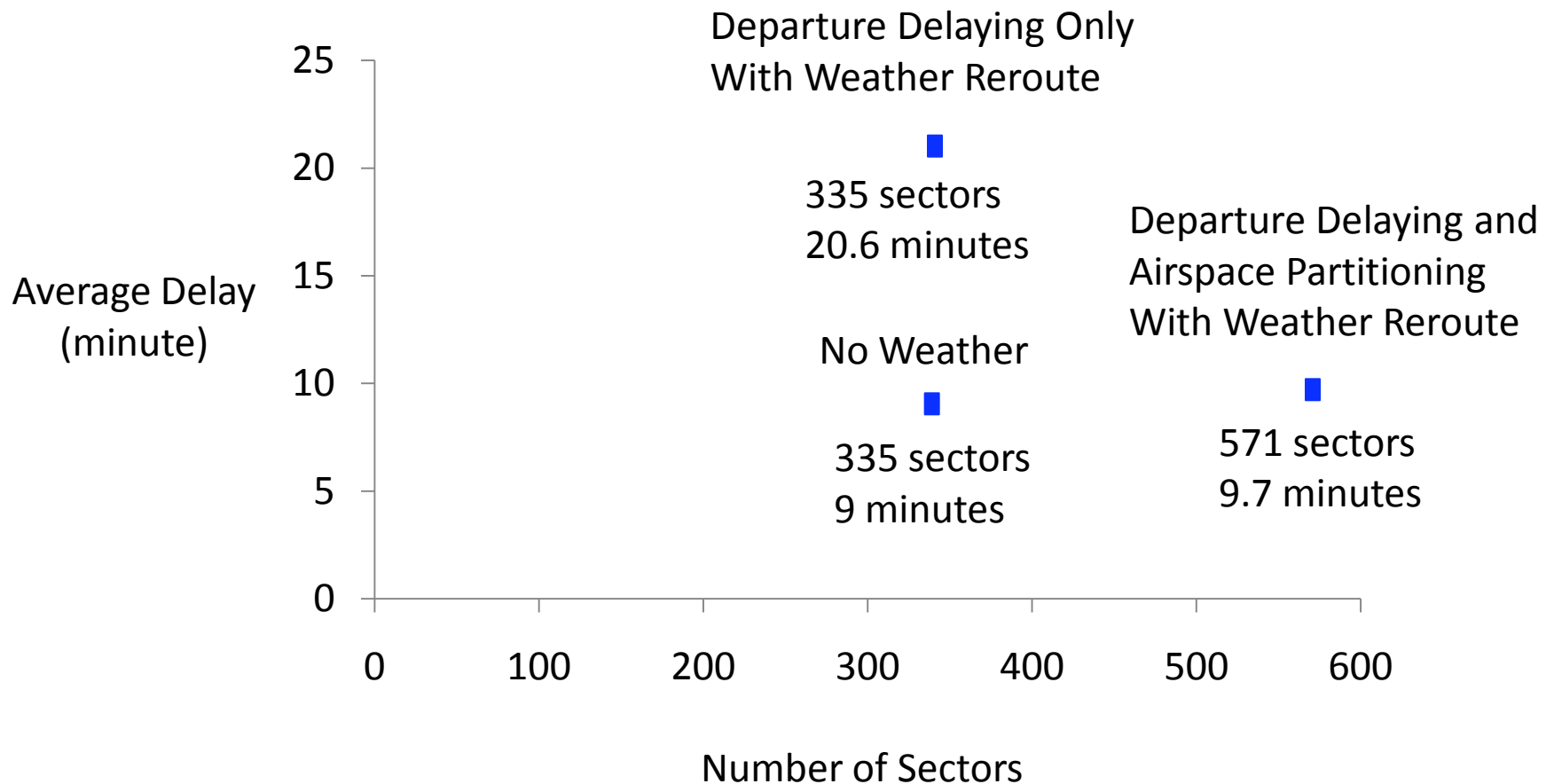
Traffic and Weather

- Traffic
 - high volume, low delay: 48,011 flights
 - no international flights
 - full day
 - 5/3/2007
- Weather
 - National Convective Weather Detection
 - level III and higher
 - 6/2/2009

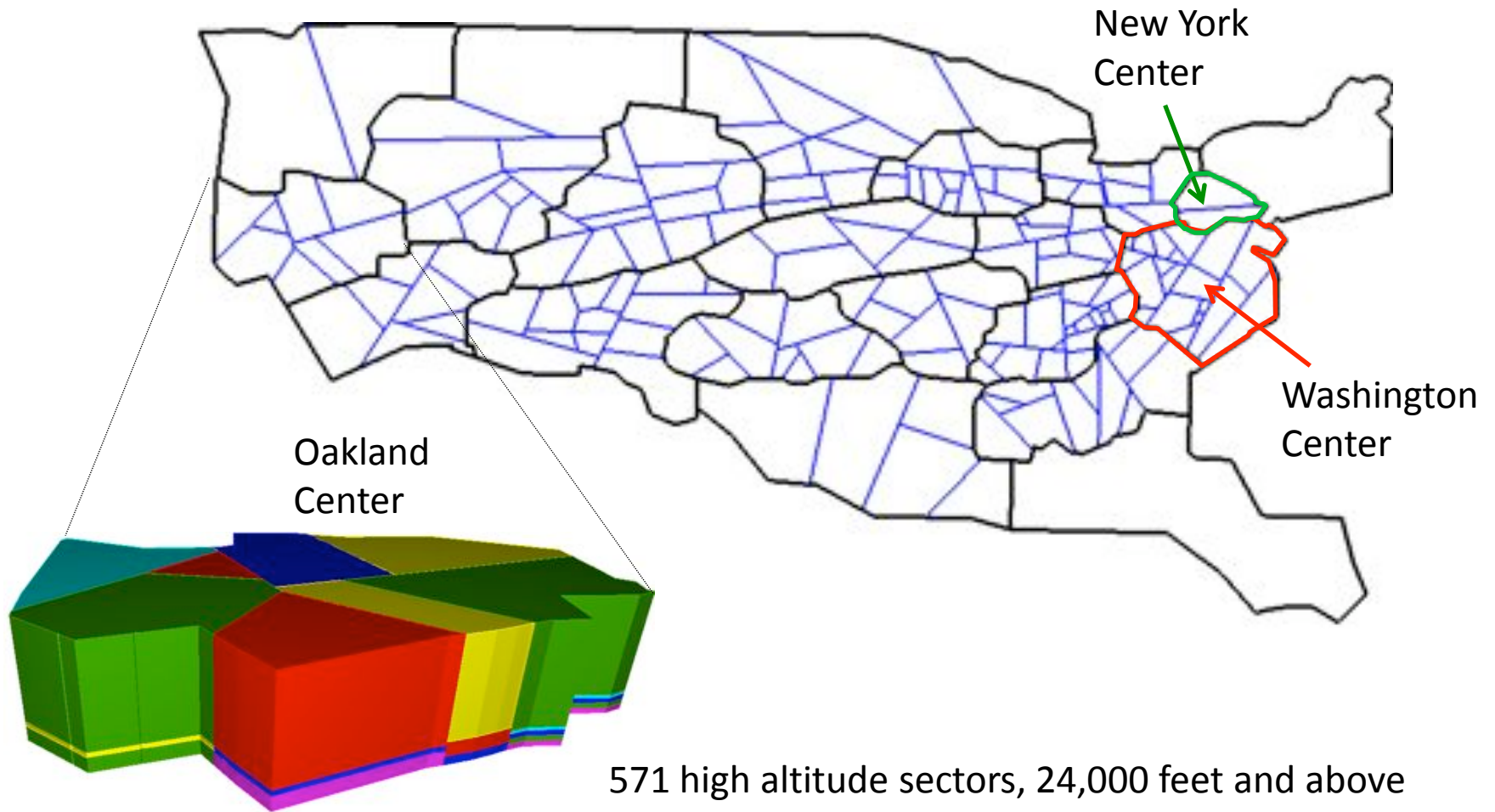
Scenarios

- No Weather
- Departure Delaying Only With Weather Reroute
- Departure Delaying and Airspace Partitioning with Weather Reroute

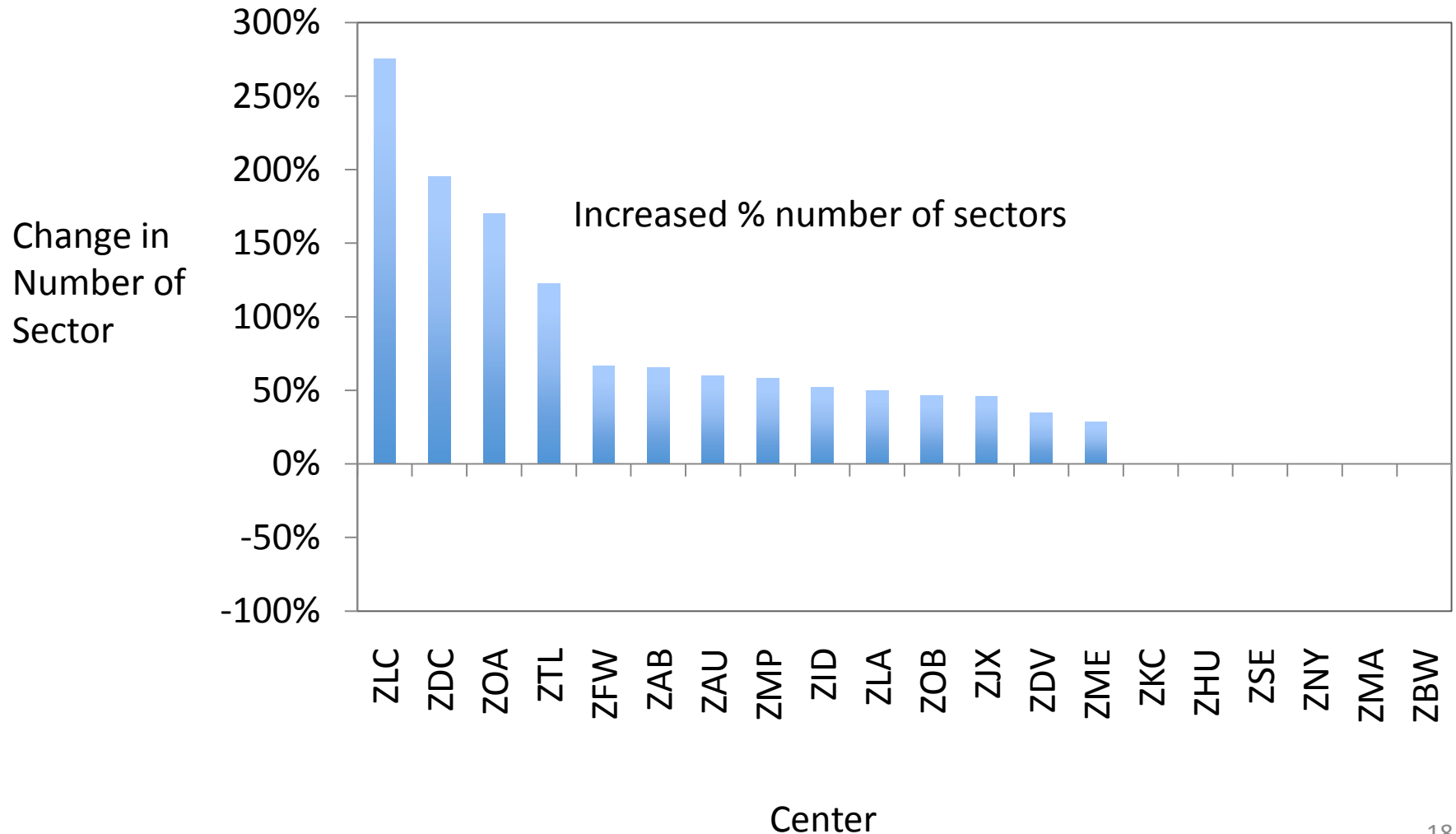
Delay Reduced by Adding Sectors



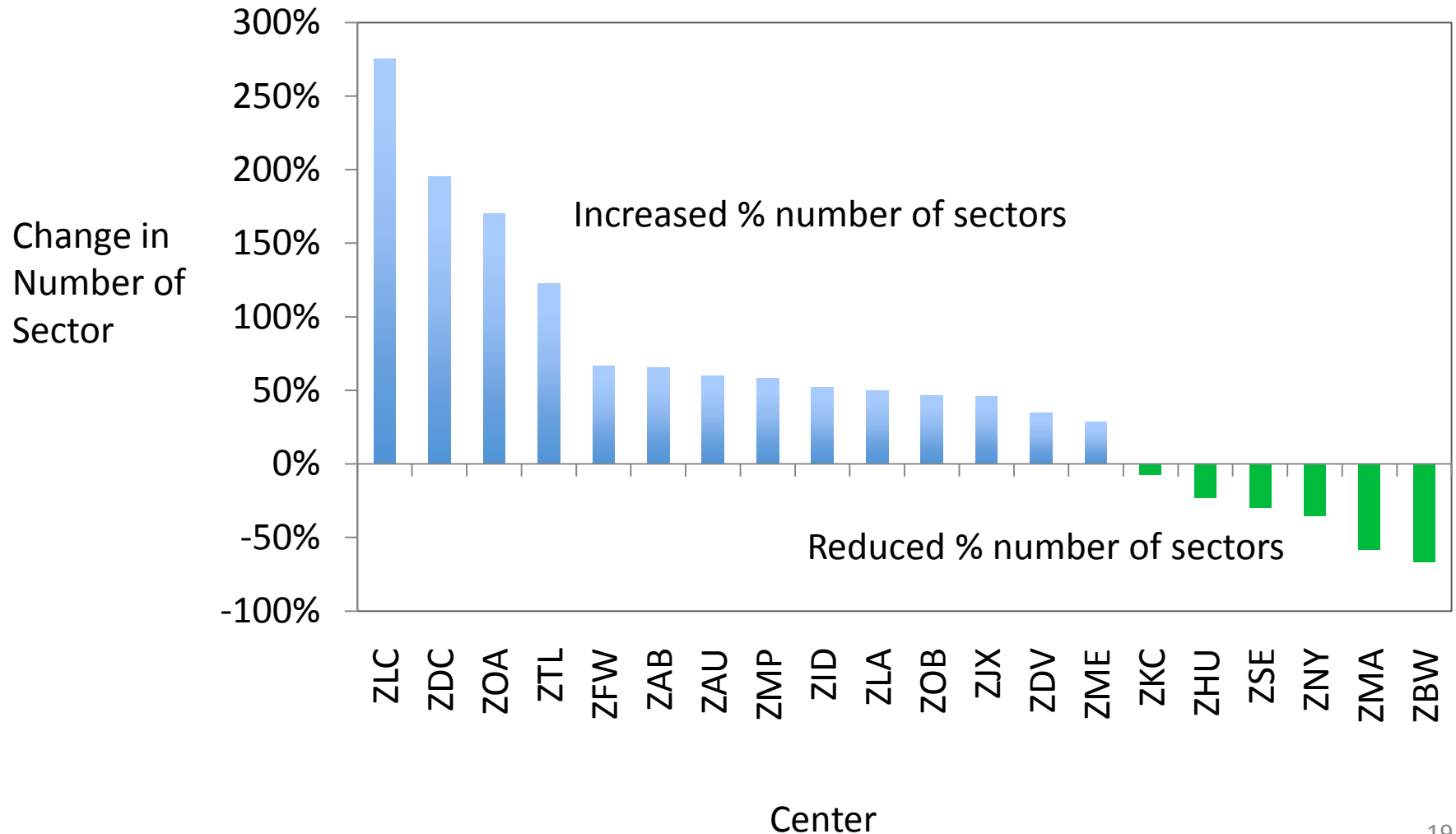
Sector Partitions



Sector Changes After Partitioning



Sector Changes After Partitioning



Summary

- Weather diverts traffic flows to adjacent sectors causing departure and airborne delays
- In our study, airspace partitioning with departure delaying, as opposed to departure delaying only
 - reduced delay by 56%, most of which is due to airspace congestion
 - increased the number of sectors by 70%

Conclusion and Recommendation

- This airspace partition is not practical
- Partition airspace as follows instead
 - shorter periods
 - incremental changes as opposed to clean-slate
 - higher capacities enabled by decision support tools

Questions?